



# MINERAL INFORMATION SERVICE

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**MINERAL INFORMATION SERVICE** is designed to inform the public on the geology and mineral resources of California and on the usefulness of minerals and rocks, and to serve as a news release on mineral discoveries, mining operations, markets, statistics, and new publications. It is issued monthly by the California State Division of Mines. Subscription price, January through December, is \$1.00.

## PETROLEUM IN CALIFORNIA

The estimated total value of crude oil produced in California in 1957 exceeded a billion dollars for the first time in history. However, the number of barrels of oil produced has been declining in the past few years. Of the mineral commodities produced in the state, crude oil ranks first in estimated value, ahead of natural gas (\$118,750,000), cement (\$107,400,000), natural-gas liquids (\$100-495,000), sand and gravel (\$83,000,000). California produces approximately 13 percent of the nation's crude oil, and is second only to Texas (41 percent) and slightly ahead of Louisiana (12 percent). Exploratory drilling in California during 1957 was about as active as the previous year, but less active than the record year of 1955 when 651 exploratory wells were drilled. Oil reserves continued to decline during the past 4 years from the record high of December 31, 1953. New reserves probably will be more difficult to find than in the past and much of our future oil reserves will be the result of deep drilling, offshore exploration and secondary methods of recovery.

### Geologic Occurrence

The important discoveries of petroleum in California have been restricted to certain areas in the San Joaquin Valley, the southern Coast Ranges, the Transverse Ranges and the Los Angeles basin. This is not accidental, but is attributable to the fact that commercial accumulations of petroleum form only in special geologic environments. Such environments pertain in a relatively small part of the area of California.

**Origin of Oil.** An estimated 99 percent or more of all the known oil in the world occurs within or in close proximity to sedimentary rocks which either contain abundant organic remains or were deposited under conditions that supported abundant plant and animal life. Although small quantities of oil have been attributed to inorganic origins, the weight of chemical and geological evidence has led to a general acceptance of the concept that all commercial deposits of petroleum and gas originated in organic matter buried in fine-grained sediments during past geologic ages. The processes by which such organic matter is transformed into petroleum are not completely understood, but such factors as bacterial action, depth of burial, temperature, pressure, catalysts, and perhaps radioactivity, are contributing causes.

**Reservoir rocks.** After formation, petroleum must migrate to and be trapped in a permeable and porous reservoir rock before a potential oil pool can exist. When the source muds are buried beneath other sediments, the accumulating weight is believed to compact the lower beds gradually, and the petroleum and other enclosed liquids are squeezed into more permeable rock such as sandstone. Then the oil and gas migrate by the action of capillarity, gas pressure, and hydraulic pressure through the reservoir rock. Where suitable traps exist, the oil is concentrated. In general, an oil reservoir rock must have sufficient pore space to contain large quantities of fluids and the fluids must be able to flow through it; that is, a reservoir rock must have high porosity and permeability in order to yield petroleum. An estimated 98 percent of the oil produced in California is obtained from fields with sandstone and conglomerate reservoir rocks. The balance of the oil is obtained from fractured shale and fractured schist reservoir rocks.

Oil in California is withdrawn from reservoir rocks that range in age from Pleistocene to pre-Cretaceous. The accompanying table shows the number of pools and their production arranged by geologic ages. Most of this production is now obtained from formations of Miocene age, although most of the cumulative production to date has been from rocks of Pliocene age.

**Oil traps.** A trap is any combination of geologic features that will stop the upward and lateral migration of petroleum and allow it to collect in a limited area. A trap may be the result of structural deformation, stratigraphic conditions, or a combination of the two. In order to be effective, the trap must lie under an essentially impervious caprock or other seal.

The known oil traps in California fields may be classified as follows:

- I. Structural traps (tectonic causes)
  1. Anticlinal
  2. Fault
  3. Fracturing
  4. Combination of above
- II. Stratigraphic traps (caused by depositional or erosional features or cementation)
  1. Depositional (lensing, buttressing)
  2. Erosional (truncation--unconformities)